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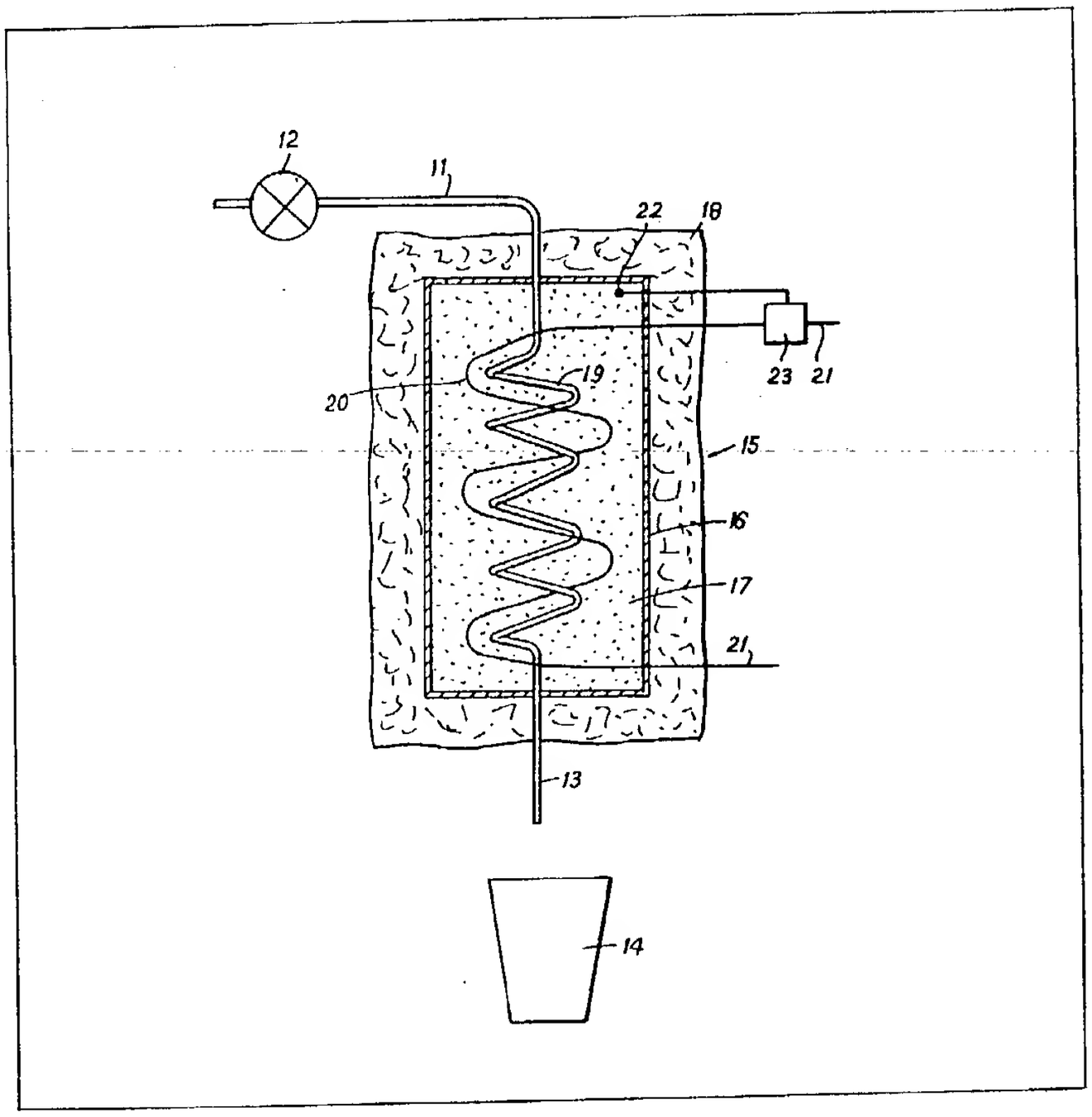
(54) Electric water heater

(57) A water heater for a vending machine comprises a helically coiled pipe 19 located in a heat sink formed by a vessel 16 filled with a thermally conductive material of high thermal capacity such as silica sand, glass, metal, water or wax 17, an helical heating coil 20 located in the heat sink and thermal insulation 18 surrounding the heat sink. A valve 12 can be opened to allow a predetermined charge of water to pass through the pipe coil 19 and during its passage the water takes up heat from the heat sink 17 so as to emerge from the delivery pipe at the temperature required for the beverage.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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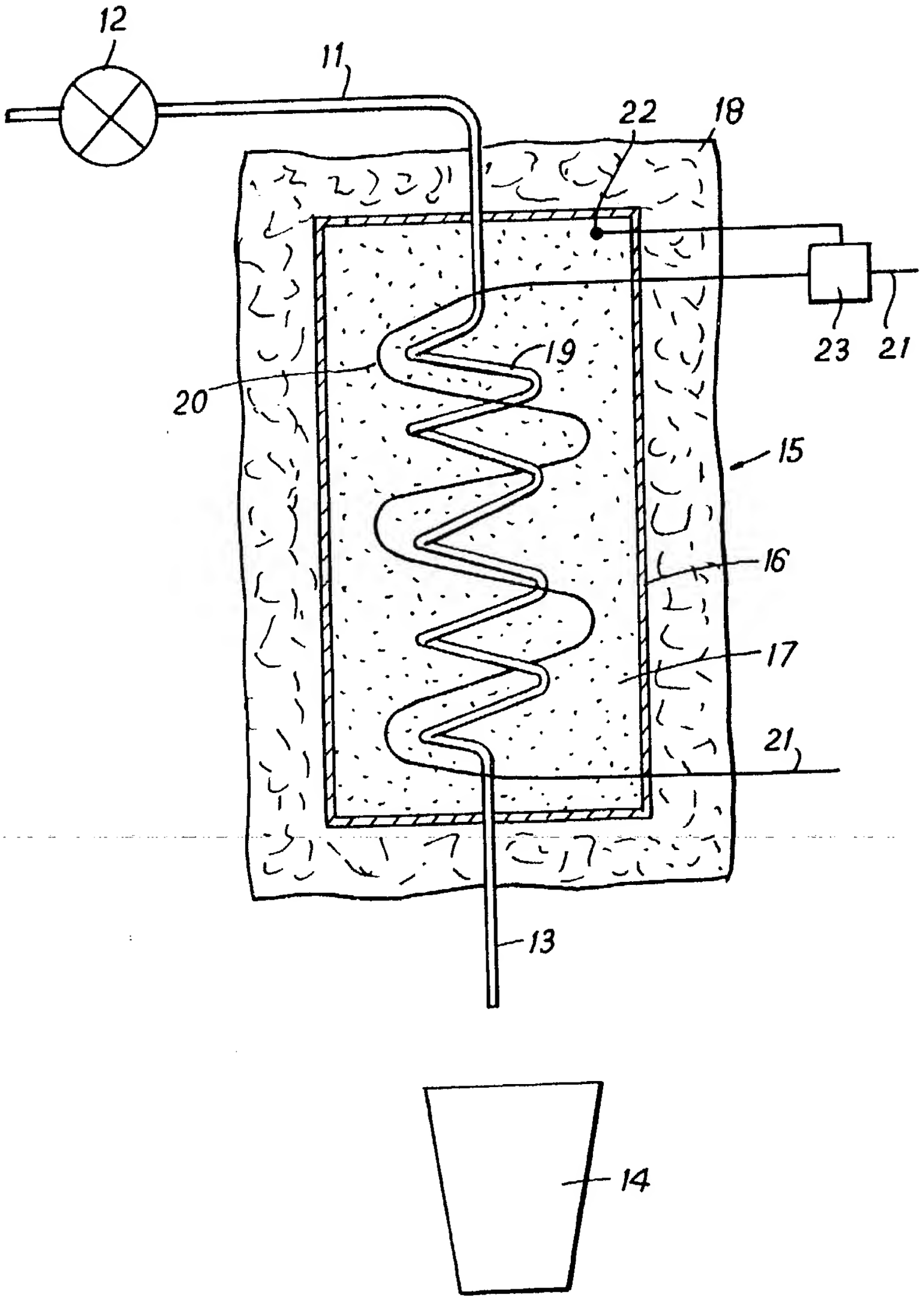

SPECIFICATION

Water heating device

The present invention relates to water heating devices and is chiefly concerned with a water heating device for use in beverage dispensing machines.

In known machines which dispense hot beverages water from a supply which may be the water main or a storage tank within the machine is fed to a "break tank" where the water is heated. Filling of the break tank is controlled by a float-controlled inlet valve so that the water level in the break tank is maintained at a particular level. The tank has a capacity equivalent to several cups and the water in the tank is heated by a thermostatically-controlled immersion heater.

The mains electricity supply usually available is 240 volts 13 amps which gives a maximum power of 3kw. This is only sufficient to heat four 170cc cups per minute assuming perfect insulation and no heat loss. In practice a machine is caused to dispense beverages at a rate of four or more cups per minute, and machines are capable of dispensing up to a rate of seven cups per minute, the temperature of the water will gradually fall to an unacceptable level.

The level control system makes the system expensive and complex. A semi-sealed tank is needed to prevent moisture escaping to other parts of the machine and to ensure hygienic storage of water. If the machine is switched off for a period of time there is a health risk caused by the stagnant water.

It is possible to use "flash heating" that is to heat each individual charge of water before delivery to the cup. In this system the heater is fed directly from the main and the water is heated in the delivery pipe by an electric heating element placed against the delivery pipe. However due to the limits on electrical power available from a 13 amps supply, heating in this way will not give a sufficient temperature rise, because the charge of water must pass through the delivery pipe in a very short time, say three seconds.

It would be possible to over-come this problem if a 6kw heater running from a 30 amps supply were used, as is already known for shower systems. However, in most offices 30 amp supplies are not available.

According to the present invention a water heater comprises a water delivery pipe and a valve which can be opened to allow a charge of water to flow through the delivery pipe, an electrical heating element and a heat sink which encloses the heating element and part of the delivery pipe and is surrounded with thermal insulation.

With this arrangement the heating element heats the heat sink before the charge of water is passed through the delivery pipe and when the water passes it is heated by the heat sink. This enables a much higher power output to be achieved in the time when the water is passing than if the water were heated directly by the heating element.

The thermal capacity of the heat sink must be sufficient to raise the temperature of the charge of water (typically 170 cc) from the temperature of the main (say 10°C) to a high enough temperature for making a beverage (say from 70 to 80°C). The construction of the heat sink must be such that the amount of heat required to produce this temperature rise can be transferred to the water in the time taken to pass through the delivery pipe. The heat sink should therefore be a thermally conducting medium.

Various materials are suitable for use as the thermally conducting medium. It could be constructed of a conducting metal or a material such as silica sand or glass. Alternatively it may be a liquid such as water or it may be a material such as wax which is maintained at a temperature just above its melting temperature so that the water will absorb the latent heat of fusion from the wax.

Preferably the delivery pipe is convoluted in the heat sink and conveniently it may be in the form of a helical coil.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings of which the sole figure is a diagrammatic representation of a water heater according to the invention.

Referring to the drawing this shows a delivery pipe 11 for a beverage-dispensing vending machine. The delivery pipe is connected to a water main which supplies cold water. The pipe includes an inlet valve 12 which is opened for a predetermined time during each vend cycle to allow a predetermined quantity of water to pass through the delivery pipe 11 through the outlet 13 to be collected in a waiting cup 14 below. The operating system for the inlet valve is conventional and therefore will not be described.

Between the inlet valve 12 and the outlet 13 is a water heater 15. The water heater 15 comprises a closed vessel 16 filled with a thermally-conductive material of high thermal capacity, for example silica sand 17. The vessel is surrounded by a jacket 18 of thermally insulating material. The delivery pipe 11 passes through the vessel 14 and the portion of the delivery pipe within the vessel is convoluted in the form of a helical coil 19. In this way a large surface area for heat transfer between the heat sink provided by the silica sand and the water in the delivery pipe is provided.

A heating coil 20 is also embedded in the sand in the vessel 16. Electricity is supplied to the heating coil through leads 21 and a sensor 22 embedded in the silica sand is connected to a thermostat 23 to control the supply of electricity to the coil so that the temperature of the sand is maintained at or near 100°C.

When the inlet valve 12 is opened the charge of water released by the valve passes through the spiral coil 19 to the outlet 13. During its passage through the coil the water takes in heat through the walls of the delivery pipe which for this purpose are formed of a suitable heat conducting metal. The stored heat in the sand provides enough heat to the water in the delivery pipe for the water emerging from the outlet pipe to be at a suitable temperature for making a beverage, typically 80°C.

The advantage of this arrangement is that it eliminates the requirement for a water tank of approved material and the associated level control system.

Although in the embodiment described above the temperature of the silica sand is maintained at about 100°C, the heat sink could be maintained at a higher temperature if required in order to obtain a more rapid heating rate for the water. If this is done it would be necessary to provide a steam release system for the vessel to prevent excessive pressure in the vessel on initial heating.

Using the system at temperatures below the boiling point of water, the system could be modified so that water is stored in the water coil between vending operations, provided the volume of water is small compared with the total amount of water dispensed during each vend cycle. When the system is operated it would discharge the very hot water plus a greater volume of cooler water to obtain the desired temperature. At the end of the vend cycle the water temperature in the coil would rise rapidly to the operating temperature.

The bore of the water coil should be sufficiently small for rapid heat transfer to take place and the flow restriction caused by the water coil should preferably be kept to a minimum so that the same apparatus may be used in areas where the mains water pressure is low.

Although in the embodiment described above, the valve 12 is shown on the inlet side of the water heater it is possible to replace the valve 12 with a valve situated on the outlet side of the heater and thus by controlling the flow of water from the heater, control the flow of water to the heater.

CLAIMS

1. A water heater comprising a water delivery pipe and a valve which can be opened to allow a charge of water to flow through the delivery pipe, an electrical heating element and a heat sink which encloses the heating element and a part of the delivery pipe and is surrounded by thermal insulation.

2. A water heater according to claim 1 in which said valve allows a predetermined volume of water to flow through the delivery pipe each time it is opened and in which the thermal capacity of the heat sink is sufficient to raise the temperature of the charge of water by 60°C as the charge passes through the delivery pipe.

3. A water heater according to claim 1 or 2 in which the heat sink is formed of metal.

4. A water heater according to claim 1 or 2 in which the heat sink is formed of sand or glass.

5. A water heater according to claim 1 or 2 in which the heat sink is a liquid.

6. A water heater according to claim 1 or 2 in which the heat sink is of a material such as wax which is maintained at a temperature just below its melting temperature so that the water passing through the delivery pipe will absorb latent heat of fusion from the wax.

7. A water heater according to any of the preceding claims in which the delivery pipe is convoluted in the heat sink.

8. A water heater according to claim 7 in which the delivery pipe includes a helical coil in the heat sink.

9. A vending machine for dispensing beverages including a water heater according to any of the preceding claims.

10. A water heater substantially as hereinbefore described with reference to the accompanying drawings.

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